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(54) A trolley for treating a part of the body with radioactive material

Karren zur Behandlung eines Körperteiles mit radioaktivem Stoff

Chariot pour traitement d'une partie du corps avec un matériau radio-actif

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EP 0 254 351 B2

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Description

This invention relates to an apparatus for treating a part of the body with radioactive material. It can be stated in general in respect of the treatment of a part of the body with radioactive material that two types of radiation can be used, i.e. a radiation for a short period of time at a high dose rate (HDR) and one for a longer period of time at a low dose rate (LDR). The first treatment method is employed among other things for treating lung cancer, whereas the second method is used mainly for treating breast cancer, cervical cancer and the like. The present patent application, however, concerns more in particular the first mentioned method (HDR). It will be clear that application of the subject matter according to the present invention to the second method (LDR) is not excluded.

The present invention relates more in particular to an apparatus for delivering a radioactive source to at least one hollow, rigid or flexible needle or applicator implanted in a part of the body of a patient such as a lung, oesophagus, brain, prostate etc., the needle or applicator being introduced in the treatment area, the apparatus comprising a shielding block for containment of the radioactive material adapted for coaction with a transport thread and transport means for transporting the radioactive material or a dummy via a connecting tube from said shielding block to said needle or applicator, the transport means being arranged before the shielding block as seen in the direction of displacement of the radioactive material, and the connecting tube having a detection point serving as a point of reference for the transport means.

Such an apparatus is disclosed in US-A-3,861,380. The dummy and the radioactive material have to be transported via the same connecting tube by the same thread and the same transport means. To this end the shielding block is first loaded with the dummy in a storage room. After wheeling the apparatus to a radiographic inspection room the connecting tube is extended and connected to an applicator placed in a part of the body of the patient. After transporting the dummy to the applicator the correct operation of the apparatus is checked, e.g. by radiographic examination. After returning the dummy to the shielding block and disconnecting and storing of the tube the apparatus is returned to the storage room to replace the dummy by radioactive material. The apparatus is then wheeled to a treatment room, the connecting tube is again extended and attached to the applicator which has remained in the patient and the treatment is carried out. A detection point shaped as an abutment member at the applicator has the intended function of preventing the dummy or the radioactive material from passing beyond the desired position. Contacting said abutment member is indicated by a light signal system which also indicates the storage position and the transfer of the radioactive material from the shielding block to the applicator. Due to the connecting and disconnecting of the tube there is no 100% guarantee of a correctly "closed" circuit for the dummy and the radioactive material.

It is an object of the present invention to remove this drawback.

To this effect, the above described apparatus is characterized in that a first connecting tube for transporting the radioactive material by a first transport means and a second connecting tube for transporting the dummy by a second transport means are joined between the shielding block and the needle or applicator, said shielding block having at least one curved channel and said detection point being provided between the joining of the tubes and the needle or applicator for serving as a point of reference for the first and the second transport means. This means that "the system is closed", with the result that it is safe. Further the joint can be situated near the shielding block.

In a further elaboration of the present invention, when use is made for driving the transport thread of a drivable disc provided with a spiral groove adapted for receiving therein the required transport thread length, use can be made of a cylindrical disc on the outer circumference of which said grooves are provided, with an endless tensioning belt being provided around a major portion of said disc, thereby achieving a proper transport thread and avoiding slip.

To ensure that no errors are made when changing the tube length, one ore more of the tubes employed consists of a helically wound wire having adjoining windings, a pull wire extending therealong, with the ends of said spring and said pull wire being attached to coupling portions, and said windings and pull wire being embedded in a synthetic plastics sheath.

By driving the disc with a stepping motor, a highly accurate positioning of the radioactive material can be obtained in a simple manner.

When the transport mechanism is provided with a drivable disc having a spiral groove, with a transport thread being received in said groove, the front end of said thread being adapted for coaction with radioactive material, such as known from Applicant's Dutch patent application 8400108, said groove may be provided on the cylindrical circumference of said disc and a tensioning belt or drive mechanism may be provided around the circumference of said disc.

For the sake of completion, it is observed that Applicant's prior Dutch patent application 8400108 (corresponding with European patent application 152 124 discloses a method and an apparatus for treating a part of the body with radioactive material, with the detection point likewise being disposed near the target area. However, compressed air is used therein, which implies that a number of additional provisions have to be made.

By driving the disc or tensioning belt by means of a stepping motor with feedback, a highly accurate, reproducible location can be obtained.

As particularly important advantages of the appara-

tus according to the present invention can be mentioned

1. Safety: An automatic test run through the applicator checks all connections and reports the position of any kinks or unsuitable curvatures, which could result in the active source jamming during treatment. In the event of this test failing, source transfer is not possible.
2. Simulation: The dummy can be used to simulate all the programmed source dwell positions (temporary stop positions) under fluoroscopy.
3. Measuring: The dummy can be used for measuring skin entry and exit points or visible tumour borders or markers. This helps the user to program his machine accurately and fast.

One embodiment of the apparatus for treating a part of the body with radioactive material will now be described, by way of example, with reference to the accompanying drawing, in which:

Fig. 1 is a perspective view of an embodiment of a trolley for use in the treatment of a part of the body of a patient with radioactive material;
Fig. 2 is a perspective detail view of the apparatus of Fig. 1;
Fig. 3 is a diagrammatic view of the treatment of a part of the body of a patient with radioactive material; and
Fig. 4 is an enlarged perspective view of the guide tube used in the apparatus shown in Figs. 1-3, with a portion of the tube removed for clarity.

As shown in the drawing, see in particular Fig. 1, a trolley adapted for treating a patient, is provided with a movable frame generally indicated at 1. Said frame supports a housing 2 accommodating a shielding block 3. Said shielding block contains a known per se curved channel for receiving therein radioactive material. However, this is extensively described in Applicant's prior Dutch patent application 84,00108, so that a further description thereof can be dispensed with.

To the front end of the housing 2 connects a guide tube 4 provided in the present case with connector 5 which, when not being used, can be suspended from a bracing rod 16. Said connector can be connected in the same manner as in Applicant's prior Dutch application to a counter-connector. In some cases, however, the front end of said guide tube 4 will be fitted with a hollow "needle" insertible into the part of the body to be treated. In the preferred embodiment, as shown in Fig. 3, two shielding blocks 3 are arranged each together with a drive mechanism 6, disposed behind each shielding block on a support foot (not shown). Each drive mechanism essentially consists of a cylindrical disc 7 on the outer surface of which there is provided a helical groove 8, adapted to receive a transport thread 9. Said transport thread 9 is taken off disc 7 by means of a tubular guide 10 whose outwardly extending end links up with the channel, not further indicated, through shielding block 3.

Transport thread 9 is retained accurately and slip-free in grooves 8 of the transport disc 7 by means of a tensioning belt 11 wrapped about the rollers 15, said belt 11 embracing said transport disc 7 through about 300°. Transport disc 7 is driven by a diagrammatically shown stepping motor 12. For the sake of completion, it is observed that at least one of rollers 15 is spring-biased.

The channels in each of the shielding blocks 3 connect to a connecting tube 13 (see Fig. 3) which are combined to a single guide tube, i.e. tube 4.

In downstream direction beyond the junction of the two connecting tubes 13, there is arranged a photoelectric cell or the like detector 14 serving as point of reference or zero point setting, and which is therefore coupled to the stepping motor 12.

As already observed in the above, the apparatus is provided with a shielding block 3 and two drive mechanisms 6. The shielding block 3 is filled with a dummy used at the beginning of the treatment of a patient (see Fig. 3) to check whether the guide tube 4 has been transported into the target area without kinks. To this effect, the dummy is advanced by means of the stepping motor from the shielding block 3 in question, with the photoelectic cell 14 or other detector serving as point of reference for the stepping motor. Besides the same shielding block 3 there is arranged, having its own transport unit 6, a further shielding block 3 containing a radioactive preparation. However, it will be clear that the apparatus may also be fitted with a different number of transport mechanisms, or with a different number of shielding blocks with radioactive material.

In order to prevent deformations of the guide tube 4, as a result of which the radioactive material could be moved to the wrong place, the guide tube, as shown in Fig. 4, consists of a metal spring having adjoining windings 16. A pull wire 17 keeping said windings in adjoining relationship is affixed to corresponding male and female coupling portions 18, 19, which are known per se. Said windings and pull wire are embedded on all sides in a synthetic plastics sheath 20.

Such a tube construction ensures that the length thereof always remains equal, so that no errors can be made in moving the radioactive sources to their destination.

The apparatus according to the present invention is especially suitable for treating a part of the body of a patient according to the HDR method: the apparatus can be brought to near the patient, the radioactive preparation can then be brought accurately into the target area, with the apparatus itself being of very simple construction.

Claims

1. An apparatus for delivering a radioactive source to at least one hollow, rigid or flexible needle or applicator implanted in a part of the body of a patient such as a lung, oesophagus, brain, prostate etc., the needle or applicator being introduced in the treatment area, the apparatus comprising a shielding block (3) for containment of the radioactive material adapted for coaction with a transport thread (9) and transport means (6) for transporting the radioactive material or a dummy via a connecting tube (13) from said shielding block to said needle or applicator, the transport means (6) being arranged before the shielding block as seen in the direction of displacement of the radioactive material, and the connecting tube having a detection point serving as a point of reference for the transport means, characterized in that a first connecting tube (13) for transporting the radioactive material by a first transport means (6) and a second connecting tube (13) for transporting the dummy by a second transport means (6) are joined between the shielding block (3) and the needle or applicator, said shielding block having at least one curved channel and said detection point (14) being provided between the joining of the tubes and the needle or applicator for serving as a point of reference for the first and the second transport means (6).

2. An apparatus according to claim 1, characterized in that the detection point (14) is situated near the shielding block (3).

3. An apparatus according to claim 1 or 2, characterized by transport means (6) including a cylindrical drive disc (7) for driving the transport thread (9), said disc having a spiral groove (8) on the outer circumference to receive therein the required transport thread length, an endless tensioning belt (11) being wrapped about a major portion of said disc (7).

4. An apparatus according to claim 3, characterized in that the disc (7) or tensioning belt (11) is driven by a stepping motor (12).

5. An apparatus according to any of the preceding claims, characterized in that one or more of the tubes employed is a helically wound wire (16) having adjoining windings, a pull wire (17) extending therealong, with the ends of said spring (16) and said pull wire being attached to coupling portions, and said windings and pull wire (17) being embedded in a synthetic plastics sheath (20).

Patentansprüche

1. Einrichtung zur Abgabe einer radioaktiven Quelle an wenigstens eine(n) hohle(n), feste(n) oder flexible(n) Nadel oder Applikator, der/die in einen Teil des Körpers eines Patienten, wie Lunge, Ösophagus, Hirn, Prostata usw., implantiert ist, wobei die Nadel oder der Applikator in das Behandlungsgebiet eingeführt ist, wobei die Einrichtung einen Abschirmblock (3) zur Eindämmung des radioaktiven Stoffs geeignet ist, mit einem Transportdraht (9) in Wirkverbindung zu stehen, und eine Transporteinrichtung (6) zum Transport des radioaktiven Stoffes oder eines Ersatzstoffes durch eine erste Verbindungsröhre (13) von dem Abschirmblock zu der Nadel oder dem Applikator umfaßt, die Transporteinrichtung (6) vor dem Abschirmblock (3), in Verlagerungsrichtung des radioaktiven Stoffes gesehen, angeordnet ist und die Verbindungsröhre einen Erkennungspunkt aufweist, der als Bezugspunkt für die Transporteinreichung dient,
dadurch gekennzeichnet,
daß eine erste Verbindungsröhre (13) zum Transport des radioaktiven Stoffs durch eine erste Transporteinrichtung (6) und eine zweite Verbindungsröhre (13) zum Transport des Ersatzstoffes durch eine zweite Transporteinrichtung (6) zwischen dem Abschirmblock (3) und der Nadel oder dem Applikator verbunden sind, wobei der Abschirmblock wenigstens einen gekrümmten Kanal hat und der Erkennungspunkt (14) zwischen der Verbindungsstelle der Röhren und der Nadel oder des Applikators vorgesehen ist, um als Bezugspunkt für die erste und die zweite Transportvorrichtung (6) zu dienen.

2. Einrichtung nach Anspruch 1,
dadurch gekennzeichnet,
daß der Erkennungspunkt (14) nahe bei dem Abschirmblock (3) angeordnet ist.

3. Einrichtung nach Anspruch 1 oder 2,
gekennzeichnet durch
eine Transporteinrichtung (6), die eine zylindrische Antriebsscheibe (7) zum Antrieb des Transportdrahts (9) einschließt, wobei die Scheibe eine spiralförmige Nut (8) auf ihrem Außenumfang aufweist, um darin die erforderliche Länge des Transportdrahts aufzunehmen, wobei ein Endlos-Spannriemen (11) um einen größeren Teil dieser Scheibe (7) geschlungen ist.

4. Einrichtung anch Anspruch 3,
dadurch gekennzeichnet,
daß die Scheibe oder der Spannriemen (11) durch einen Schrittmotor (12) angetrieben ist.

5. Einrichtung nach einem der vorangehenden

Ansprüche,
dadurch gekennzeichnet,
daß eine oder mehrere der verwendeten Röhren ein schraubenlinienförmig gewundener Draht (16) mit aneinanderliegenden Windungen ist, wobei sich ein Zugdraht (17) diesen entlang erstreckt, wobei die Enden der Feder (16) und der Zugdraht an Anschlußteile angebracht sind und wobei die Windungen und der Zugdraht (17) in eine Kunststoffhülle (20) eingebettet sind.

Revendications

1. Dispositif pour acheminer une source radioactive jusqu'à un certain nombre d'aiguilles ou d'applicateurs creux, pouvant être rigides ou flexibles, implantés dans une partie du corps d'un patient, comme par exemple les poumons, l'oesophage, le cerveau, la prostate, et ainsi de suite, l'aiguille ou l'applicateur étant planté dans la zone à traiter, le dispositif comprenant un bloc de blindage (3) contenant la substance radioactive et apte à fonctionner en association avec un fil d'entraînement (9) et des moyens de transfert (6) servant à conduire la substance radioactive ou une substance de simulation le long d'un tube de raccordement (13) à partir dudit bloc de blindage jusqu'à ladite aiguille ou ledit applicateur, les moyens de transfert (6) étant disposés en amont du bloc de blindage dans la direction de déplacement de la substance radioactive, et le tube de raccordement possédant un point de détection qui sert de point de référence pour les moyens de transfert, caractérisé en ce qu'un premier tube de raccordement (13) servant à conduire la substance radioactive à l'aide de premiers moyens de transfert (6), et un second tube de raccordement (13) servant à conduire la substance de simulation à l'aide de seconds moyens de transfert (6), font jonction entre le bloc de blindage (3) et l'aiguille ou applicateur, ledit bloc de blindage comportant un certain nombre de conduits incurvés, et ledit point de détection (14) étant placé entre le point de jonction des tubes et l'aiguille ou applicateur, pour servir de point de référence aux premiers et seconds moyens de transfert (6).

2. Dispositif selon la revendication 1, caractérisé en ce que le point de détection (14) est situé à proximité du bloc de blindage (3).

3. Dispositif selon la revendication 1 ou 2, caractérisé en ce que les moyens de transfert (6) comprennent un disque cylindrique d'entraînement (7) servant à entraîner le fil d'entraînement (9) et dont la circonférence externe comporte une gorge en spirale (8) destinée à loger la longueur requise de fil d'entraînement, une courroie sans fin de mise en tension (11) étant enroulée autour d'une partie importante dudit disque (7).

4. Dispositif selon la revendication 3, caractérisé en ce que le disque (7) ou la courroie de mise en tension (11) est entraîné par un moteur pas-à-pas (12).

5. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce qu'un ou plusieurs des tubes utilisés est un fil (16) enroulé selon une disposition hélicoïdale et possédant des spires jointives, un fil de traction (17) s'étendant le long de ces spires, les extrémités dudit ressort (16) et dudit fil de traction étant fixées à des parties d'accouplement, et lesdites spires et ledit fil de traction (17) étant enrobés dans une gaine en matière plastique synthétique (20).

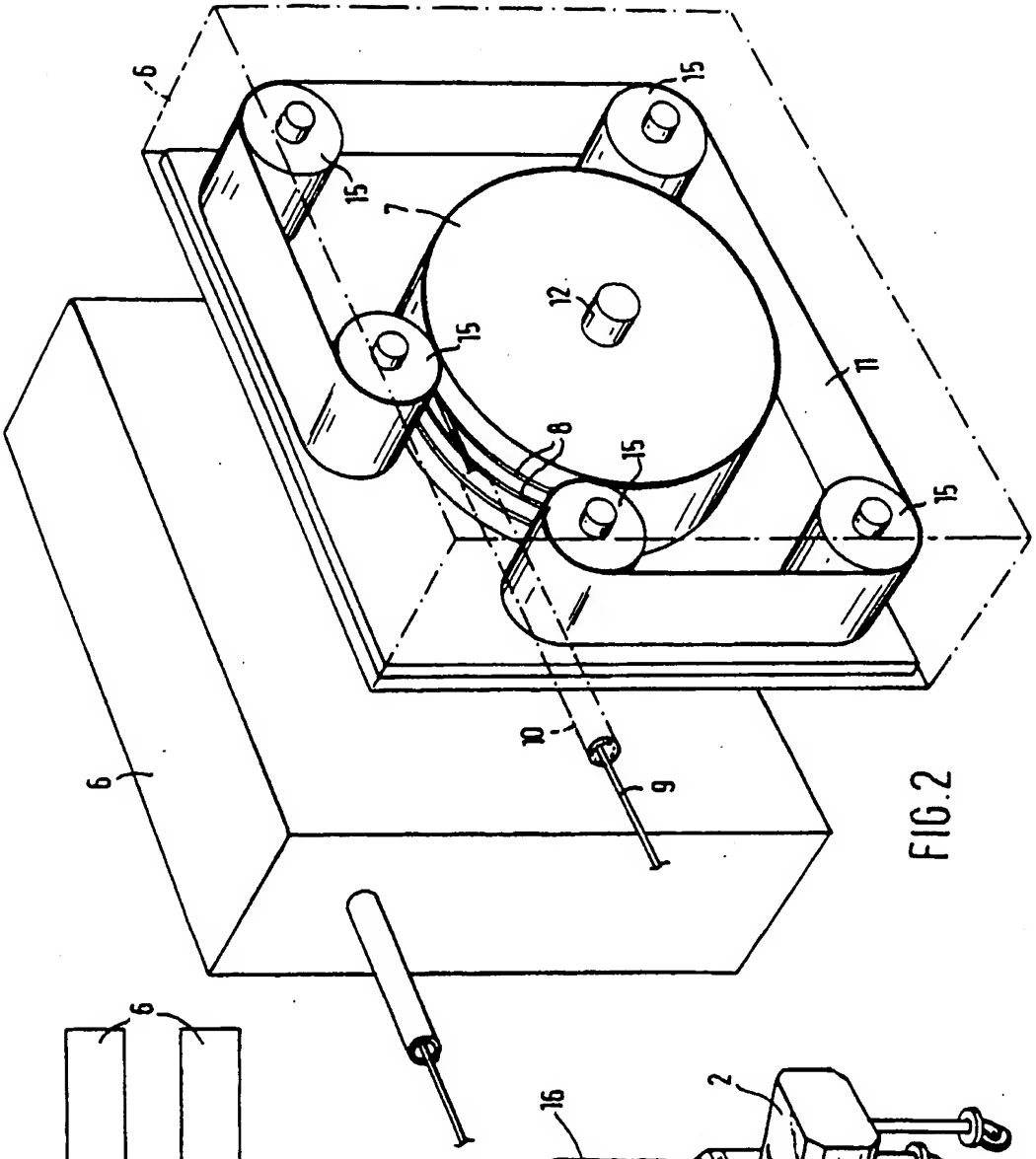

FIG.2

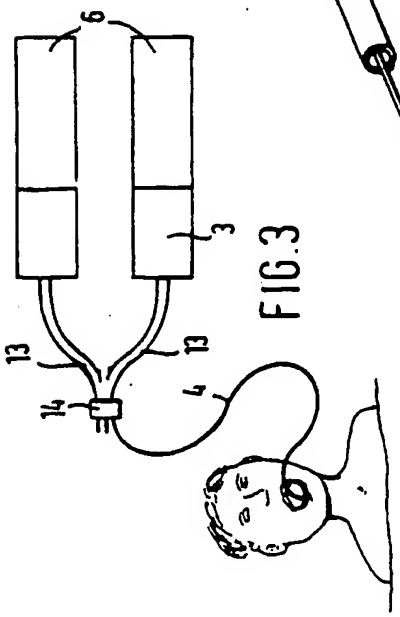

FIG.3

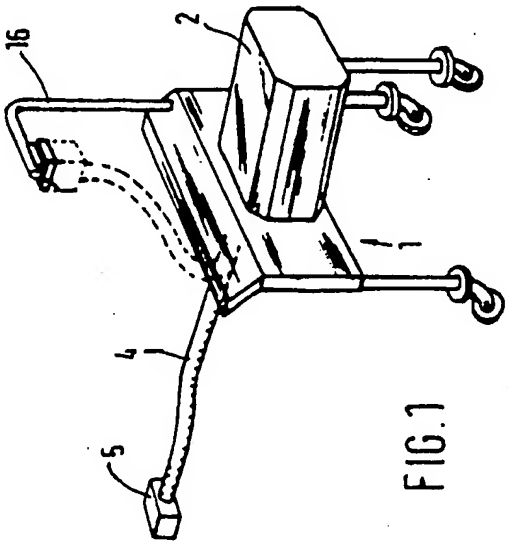

FIG.1

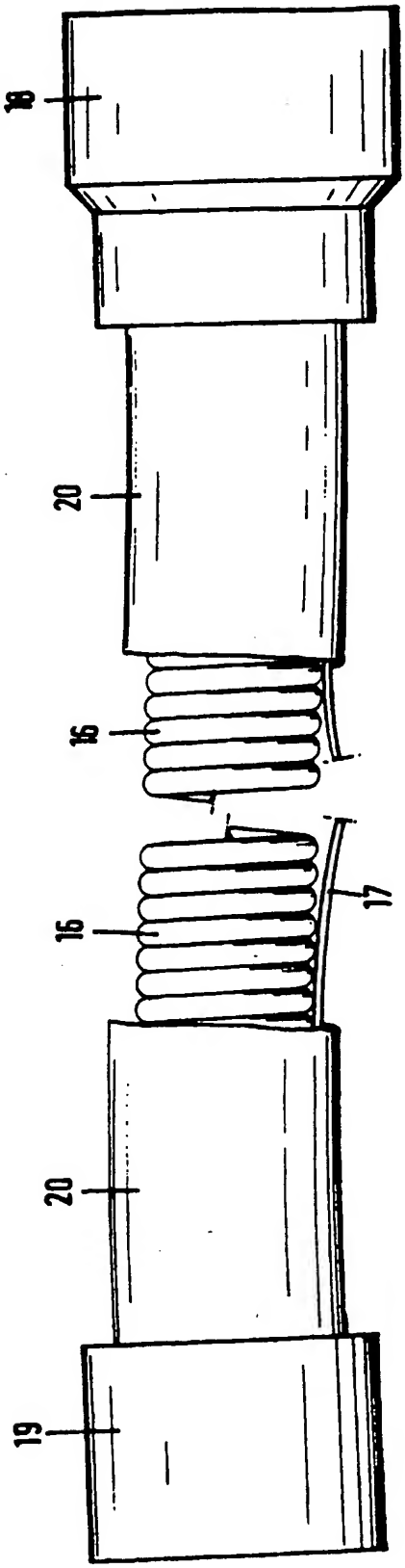

FIG.4